Remarks

This is in response to the Office Action mailed January 2, 2004, in the above-referenced application. Claims 28-44 are pending. Claims 1-27 have been withdrawn from consideration as drawn to a non-elected invention.

Claims 35 and 44 are amended as noted above to correct apparent typographical errors. The amendments are not made for a reason relating to the patentability of the claimed invention. Accordingly the amendments do not affect the scope of protection afforded Applicants, including any scope of protection available under the Doctrine of Equivalents.

New claims 45 and 46 are added to complete the record for consideration by the Examiner. Support for Claim 45 can be found in the application as filed, for example, at paragraphs [0052] and [0054]. Support for Claim 46 can be found in the application as filed, for example, at paragraphs [0053] and [0089]. Entry and consideration of Claims 45 and 46 are respectfully solicited.

Applicants note with appreciation the indication of the allowance of Claim 44. The rejections of record of the remaining claims are addressed below in the order presented in the Office Action. Withdrawal of the rejections of record and reconsideration of the patentability of the claimed invention are respectfully solicited in view of the following comments.

Applicants confirm the provisional telephone election with traverse to prosecute the invention of Species II (Figure 11, Claims 28-44). Claims 1-27 are accordingly withdrawn from consideration. Applicants expressly reserve the right to file divisional applications or take other appropriate measures deemed necessary to protect the invention in the non-elected claims.

The Office objects to Figures 10 and 11 of the present application as failing to show cavity 23. Applicants respectfully note that cavity 23 is illustrated in other drawings, including Figures 1-4. Cavity 23 is also described throughout the application, for example at paragraphs [0058], [0060], [0063]-[0066], [0068]-[0069], [0071], [0074]-[0078], [0080], and [0085]. Applicants respectfully submit that the figures and specification together as currently

presented sufficiently describe the invention and allow for a complete understanding of the subject matter to be patented as required by the Patent Statute. Accordingly, Applicants respectfully submit that correction of Figures 10 and 11 is not required and request withdrawal of this objection.

The objections to the specification are addressed as follows.

Paragraph [0057] (referred to as paragraph 56 in the Office Action) is amended to insert the requested serial numbers. Reference is made to paragraph [0001] which cross references the noted copending patent applications. In addition, Applicants respectfully submit that single mode focused microwave devices are known in the art. Accordingly this amendment does not add new matter.

Paragraph [0068] (referred to as paragraph 67 on the Office Action) is amended to correct an apparent typographical error noted by the Examiner, namely, to insert references to Figure 2. This amendment also does not add new subject matter.

Applicants respectfully request entry of these amendments and withdrawal of the objections to the specification.

Claims 34-35 and 38 are rejected under 35 USC Section 102(b) as anticipated by U.S. Patent No. 4,225,235 to Anderson et al. Applicants respectfully traverse this rejection.

By way of background the present invention is directed generally to methods and instruments for microwave assisted chemistry. Microwaves have been used in various chemical processes, including microwave drying for loss-on-drying moisture content analysis, sample digestion prior to downstream analytical analysis, and the like.

While microwave devices can be useful in such processes, it can be difficult to use microwave assisted chemical techniques in other types of chemical processes. For example, organic synthesis generally requires greater control of the application of microwave energy to a sample.

Conducting microwave assisted organic synthesis in a continuous process can be helpful, yet limitations still exist. For example, the nature of microwave energy can generally result in relatively rapid temperature increases, up to and beyond desired levels for a particular application. Undesirably high temperatures can lead to product decomposition. The generation of volatile byproducts at increased temperatures can also result in increased pressure conditions. Increased pressures can in turn undesirably change reaction kinetics and even physically damage reaction vessels or instruments. Reducing microwave power can reduce temperatures, but this can negatively impact the efficiency of a given reaction.

The methods and instruments of the present invention can provide greater control of the use of microwave power in various chemical techniques, including organic synthesis. For example, the invention can allow the synthesis of organic products at controlled temperatures while maximizing the use of microwave energy in a given application.

Claims 34-35 and 38 are directed to instruments of the invention for microwave assisted chemistry. The instrument includes a microwave cavity; a flow cell in the cavity; a spectroscopy cell external to the cavity and in fluid communication with the flow cell; and a spectrometer with the spectroscopy cell in the optical path of the spectrometer for analyzing characteristics of fluids flowing from the flow cell and through the spectroscopy cell.

As discussed at paragraph [0089] of the present application, the spectrometer includes a source and a detector, arranged so that the source emits electromagnetic radiation within a particular frequency range through the sample and thereafter to a detector. Paragraph [0089] defines the optical path as "the path defined between the source 111 and the detector 112." The difference between the radiation emitted by the source and collected by the detector can be used to identify particular characteristics of components of the sample stream. New claim 46 is added to further clarify that the spectrometer is an absorption spectrometer with a radiation source and a detector.

In contrast to the present invention, Anderson et al. do not teach an instrument for microwave assisted chemistry. Rather, the Anderson et al. apparatus uses microwave excitation to generate emitted light for analysis purposes only. To this end, the Anderson et al. apparatus includes a sample introduction system, designated generally at 30, that vaporizes and disassociates a sample introduced into a microwave chamber 15. An inert gas is also introduced into a microwave chamber 15. Microwave energy excites the inert gas, and the excited inert gas contacts the vaporized sample so that it emits light. A collection optics system 20 collects and focuses the emitted light into a detection system 21 that measures the light intensity at the wavelengths of interest.

The Office Action incorrectly characterizes various components of the Anderson et al. apparatus (a reaction chamber 11, collection optics system 20, and detection system 21) as being the same as the spectroscopic cell, optical path and spectrometer as claimed. Anderson et al., however, do not teach an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell. Accordingly, the Anderson et al. patent does not anticipate Claims 34-35 and 38, and Applicants respectfully request withdrawal of this rejection.

Claims 34-35 are rejected under 35 USC Section 102(b) as anticipated by U.S. Patent No. 4,427,633 to Peacock et al. Applicants respectfully traverse this rejection.

Similar to Anderson et al., Peacock et al. do not teach an instrument for microwave assisted chemistry as claimed. Rather, the Peacock et al. patent is also directed to a device that uses microwave excitation to generate emitted light for analysis purposes only. In particular, Peacock et al. focus on a specified manifold structure 14, designed to improve mixing of a metastable gas and a sample gas and to minimize loss of sample on the walls of the apparatus.

Also similar to Anderson et al., the Office Action incorrectly characterizes various components of the Peacock et al. apparatus as the same as the spectroscopic cell, optical path and spectrometer as claimed. Peacock et al., however, also do not teach an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell. Accordingly, the Peacock et al. patent does not anticipate Claims 34-35 and 38, and Applicants respectfully request withdrawal of this rejection.

Claims 28-30, 33 and 37 are rejected under 35 USC Section 103(a) as unpatentable over Anderson et al. in view of U.S. Patent No. 6,268,596 to Lauf et al. Applicants respectfully traverse this rejection.

Claims 28-30 and 33 are directed to a method of microwave assisted chemistry that includes the step of directing a continuous flow of fluid through a single mode microwave cavity while applying microwave radiation to the cavity and to the continuous flow of material therein. The fluid is then directed from the cavity to a spectroscopic flow cell and spectroscopically analyzed or evaluated. The conditions of the microwave cavity are thereafter controlled or moderated in response to the spectroscopic analysis.

As noted above, the sample can be spectroscopically analyzed using a spectrometer, in which a source directs electromagnetic radiation within a particular frequency range through the sample and thereafter to a detector. The difference between the radiation emitted by the source and that collected by the detector can be used to identify particular characteristics of components of the sample stream. Thus the spectroscopic analysis allows the user to monitor the compositional makeup of the sample stream. This in turn allows the user to quickly identify products, byproducts, unreacted starting materials, and the like.

Based upon the results of the spectroscopic analysis, the conditions of the continuous microwave assisted reaction can be adjusted as necessary. For example, the microwave cavity conditions can be moderated by moderating the microwave power applied to the cavity, as recited in Claim 33.

The Office acknowledges that Anderson et al. do not teach a single mode microwave cavity as recited in method claim 28 and instrument claim 37. Applicants submit, however, that Anderson et al. differ in several additional significant aspects from the claimed invention. Anderson et al. do not teach a method of microwave assisted chemistry including a step of moderating conditions within a microwave cavity in response to spectroscopic analysis. As discussed above, Anderson et al. also do not teach an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell.

There is no motivation to combine the teachings of Anderson et al. and Lauf et al. Lauf et al. is directed to an apparatus having a different function and structure than that of Anderson et al. In contrast to Anderson et al., the Lauf et al. apparatus is designed for microwave heating of a sample. Lauf et al. focus in particular on "field perturbing tools," designated as 36 and 36" in Figures 1 and 2, respectively. The field perturbing tools are stated to better stir or perturb a microwave field to more thoroughly heat a sample.

Further, neither Anderson et al. nor Lauf et al. recognize the problems addressed by the present invention. Neither identifies the need to provide better control of conditions within an instrument used for microwave assisted chemistry without negatively affecting the reaction conditions. The cited patents certainly do not teach or suggest a process for microwave assisted chemistry in which a fluid sample is spectroscopically analyzed and conditions within the microwave cavity are moderated in response to the spectroscopic evaluation, nor do the cited patents teach or suggest an instrument constructed to allow such analysis.

Even if one were to combine the teachings of the cited patents, the result would not be the same as that claimed. At best, one skilled in the art would include a single mode microwave cavity in the Anderson et al. apparatus. Yet, the resultant apparatus would still lack several features of the claimed invention. For example, the proposed combination still

would not allow for moderating conditions within the microwave cavity in response to spectroscopic analysis. The proposed combination also would not result in an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell.

In summary, the cited patents do not teach or suggest the claimed invention. Even if one were to combine the teachings of the cited patents, the result would not be the same as claimed. Accordingly, Applicants respectfully submit that the claimed invention is patentable over Anderson et al. and Lauf et al. and request withdrawal of this rejection.

Claims 31 and 36 are rejected under 35 USC Section 103(a) as unpatentable over Anderson et al. in view of Lauf et al. and further in view of U.S. Patent No. 5,235,251 to Schlie. Applicants traverse this rejection.

The deficiencies of Anderson et al. and Lauf et al. are discussed above. Schlie is directed to a microwave excited plasma system, such as that used in lasers and lamps. Thus Schlie is directed to yet another type of apparatus that differs structurally and functionally from the apparatus of Anderson et al. and Lauf et al., as well as from the claimed invention.

Schlie includes a cooling system, represented in Figure 4 as a cooling jacket 51 surrounding a plasma tube 43, through which hydraulic fluid flows to serve as a coolant of the plasma. Hydraulic fluid is selected as the coolant because of its negligible absorption of microwave energy at certain energy levels.

As with Anderson et al. and Lauf et al., Schlie does not recognize the problems addressed by the present invention. Schlie does not teach or suggest an instrument for microwave assisted chemistry or methods of using the same, much less such instruments and methods using spectroscopic analysis for moderating or controlling conditions within a microwave cavity. Schlie certainly does not teach or suggest a cooling system and methods of using the same to moderate conditions in a microwave cavity in response to spectroscopic analysis.

Indeed, overheating is not recognized as an issue for either the Anderson et al. or the Lauf et al. apparatus. Thus there is no motivation or suggestion to incorporate a cooling system such as that of Schlie into the Anderson et al. apparatus.

Even if one were to combine the teachings of the cited patents, the result would not be the same as claimed. At best, one skilled in the art would add a cooling system to the Anderson et al. apparatus. Yet, such a combination would still lack several features of the claimed invention. The resultant apparatus still would not allow for moderating conditions within a microwave cavity in response to spectroscopic analysis. The proposed combination also would not result in an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell. Accordingly Applicants submit that Claims 31 and 36 are also patentable over the cited patents and respectfully request withdrawal of this rejection as well.

Claim 32 is rejected under 35 USC Section 103(a) as unpatentable over Anderson et al. in view of Lauf et al. and further in view of U.S. Patent No. 5,387,397 to Strauss et al. Applicants respectfully traverse this rejection as well.

The deficiencies of Anderson et al. and Lauf et al. are discussed above. Strauss et al. measure effluent temperature to determine the temperature of a reaction in a microwave chamber. Other factors, including feed flow rate, can be adjusted in response to the measured effluent stream temperature.

In contrast to Strauss et al., however, the claimed invention moderates microwave cavity conditions based upon spectroscopic analysis. Strauss et al. nowhere teaches or suggest this as a mechanism for controlling reaction conditions. Further, having apparently solved the problems associated with controlling reaction conditions, there is no motivation for one skilled in the art to select a significantly different control mechanism. To conclude otherwise requires an improper hindsight analysis of Applicants' own teaching to supply the

requisite motivation. Accordingly, Applicants submit that Claim 32 is also patentable over the cited art and respectfully request withdrawal of this rejection as well.

Claims 39-40 are rejected under 35 USC Section 103(a) as unpatentable over Anderson et al. in view of Lauf et al. and Schlie and further in view of U.S. Patent No. 5,313,061 to Drew et al. Applicants respectfully traverse this rejection.

The deficiencies of Anderson et al., Lauf et al. and Schlie are discussed above. The Drew et al. apparatus differs even more significantly from the apparatus of the other cited patents, as well as from that of the claimed invention. In particular, the Drew et al. apparatus is a portable self-contained miniaturized system, intended for use in remote locations. The apparatus does not use microwave energy for any purpose, much less microwave energy for microwave assisted chemistry as claimed. Thus there is no motivation to combine the teachings of Drew et al. with the other cited patents.

Even if one were to combine the teachings of the cited patents, the result would still not be the same as that claimed. As discussed above, Anderson et al. (as well as the other cited patents) do not teach an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell. Thus picking and choosing from among the various components of the unrelated systems of the cited art, including a processor as discussed in Drew et al., and adding the components to the apparatus of Anderson et al. still would not result in the claimed invention. Concluding otherwise requires an improper hindsight analysis of Applicants' own invention. Accordingly Applicants submit that Claims 39-40 are also patentable over the cited patents and respectfully request withdrawal of this rejection as well.

Claims 41-42 are rejected under 35 USC Section 103(a) as unpatentable over Anderson et al. in view of Lauf et al., Schlie, and Drew et al. and further in view of Strauss et al. Applicants respectfully traverse this rejection.

The deficiencies of Anderson et al., Lauf et al., Schlie and Drew et al. are discussed above. Also as discussed above, Strauss et al. address the problem of temperature control in a microwave enclosure in a significantly different way than the claimed invention. Strauss et al. measure effluent temperature to determine the temperature of the reaction. Other factors, such as pressure, are thereafter adjusted in response to the measured effluent stream temperature.

In contrast to Strauss et al., the claimed invention moderates microwave cavity conditions based upon spectroscopic analysis. Strauss et al. nowhere teaches or suggest this as a mechanism for controlling reaction conditions. Further, having apparently solved the problems associated with controlling reaction conditions, there is no motivation for one skilled in the art to select a significantly different control mechanism, without relying improperly on Applicants' own teaching to supply the requisite motivation.

Even if one were to combine the teachings of the cited patents, the result would still not be the same as that claimed. As discussed above, Anderson et al. (as well as the other cited patents) do not teach an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell. Thus picking and choosing from among the various components of the unrelated systems of the cited art, including a pressure detector as discussed in Strauss et al., and adding the components to the apparatus of Anderson et al. still would not result in the claimed invention. Concluding otherwise also requires an improper hindsight analysis of Applicants' own invention. Accordingly, Applicants submit that Claims 41-42 are also patentable over the cited art and respectfully request withdrawal of this rejection as well.

Claim 43 is rejected under 35 USC Section 103(a) as unpatentable over Anderson et al. in view of Lauf et al., Schlie, and Drew et al. and further in view of U.S. Patent No. 6,607,902 to Jennings et al. Applicants respectfully traverse this rejection.

The deficiencies of Anderson et al., Lauf et al., Schlie, and Drew et al. are discussed above. All of the cited patents, including Jennings et al., are directed to various structurally and functionally distinguishable apparatus. To conclude that Claim 43 is obvious, the Office must pick and choose among the various teachings of the patents and piece these together, relying upon Applicants' own specification as a blueprint. Such an analysis is improper.

Even if one were to combine the teachings of the cited patents, the result would still not be the same as that claimed. As discussed above, Anderson et al. (as well as the other cited patents) do not teach an instrument that includes a spectrometer with a spectroscopy cell positioned in the optical path thereof so that radiation emitted from the spectrometer can be absorbed by fluids flowing through the spectroscopy cell. Thus picking and choosing from among the various components of the unrelated systems of the cited art, including a waveguide as discussed in Jennings et al., and adding the components to the apparatus of Anderson et al. still would not result in the claimed invention. Concluding otherwise also requires an improper hindsight analysis of Applicants' own invention. Accordingly Applicants submit that Claim 43 is also patentable over the cited patents and respectfully request withdrawal of this rejection as well.

The rejections of record having been addressed in full in the foregoing, Applicants respectfully submit that the present application is in condition for allowance, which action is respectfully solicited. Should the Examiner have any questions regarding the foregoing, it is respectfully requested that the Examiner contact the undersigned at his convenience to expedite examination and allowance of this matter.

It is not believed that extensions of time or fees for net addition of claims are required beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration

of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 50-0332.

Respectfully submitted,

Melissa B. Pendleton

Melissa B. Pendleton
Reg. No. 35,459

021176
Summa & Allan, P.A.
11610 N. Community House Rd., Suite 200
Ballantyne Corporate Park
Charlotte, North Carolina 28277-2162
Telephone: 704-945-6700
Facsimile: 704-945-6735
\\Server\F\FIRM DOCS\1700\119\Amendment 060204.doc

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I hereby certify that this correspondence is being transmitted by facsimile to the U.S. Patent and Trademark Office, c/o Technology Center 3700, Attn: Examiner Quang T. Van, at facsimile number 703-872-9302 on June 2, 2004.

Andie Crumpler

Andie Crumpler